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November 4, 2019

Jamie Teague, Business Administrator
Norwich School District
41 Lebanon Street #2
Hanover, New Hampshire 03755

RE: CONCEPTUAL ALTERNATIVES EVALUATION UPDATE FOR MARION CROSS SCHOOL, NORWICH, VERMONT (Project No. 11647)

Dear Jamie:

Since our initial conceptual alternatives evaluation, summarized in our August 31, 2018 correspondence to you, we have continued to work with Norwich School District (District) representatives and team members to refine the evaluation of the existing Marion Cross School (MCS) on-site wastewater disposal system (System). The following paragraphs present our general efforts to assist the District with better understanding System issues and alternatives.

The MCS System

We have continued to support the District's ongoing desire to explore and exhaust options to repair or replace the existing System on the Green. Our efforts, which emanated from sampling effluent in early 2018, have included the following considerations:

1. **The System and the Problem**: The System was approved based on plans prepared by K.A. LeClair Associates, Inc. (LeClair) in 1988. The LeClair plans relied on hydrogeological analyses prepared by Wagner, Heindel, and Noyes (WHN), contemporaneous with Vermont Agency of Natural Resources (VANR) regulations, and what we infer as significant interaction with VANR representatives.

    a. The LeClair/WHN plans were approved in 1988 by the VANR for a System capacity of approximately 10,000 gallons per day (gpd) as an Indirect Discharge Permit (IDP), which was (and is) required for flows greater than 6,499 gpd, under Permit No. ID-9-0021.
    b. The 1988 System included effluent treatment in four leachfields with a capacity of 5,000 gallons each. System sizing was based on 1.2 gallons per square foot, resulting in bed sizes of 4,200 square feet.

        - The existing System diagram presented as Attachment 5 in our August 31, 2018 report to the District was based on attempting to match 1988 design plans with publically available aerial information; we are not aware of any record drawings or information that document the actual location of the existing System.
        - We have identified likely conflicts between the existing System and setback requirements, which we have discussed with Terry Shearer, VANR District 3 Engineer, and District representatives. Examples include paved walkways, drainage facilities, Girard Drive, and possibly a

water line (all of which need to be identified and vetted if the District chooses to replace the existing System).

c. Anecdotally, the System exhibited problems within 10 years of approval in terms of odors and the apparent effluent breakout at the surface, which has persisted over the years. Our understanding of anecdotal information is that problems appear to have occurred during frozen conditions through winter and spring months.

d. While the public record does not document steps taken by the District to address System issues, the District revised its permit, on March 23, 2008 under permit number WW-3-0026-R to accommodate a reduction in flow to 5,460 gpd for 364 students and staff. Our understanding is that effluent continued to reach the surface in the winter months after 2008.

e. The District asked us to assist with collecting and analyzing samples of apparent effluent reaching the surface on Friday, January 26, 2018 in very cold conditions. We were able to collect samples on Monday, January 29, 2018 for testing. We provided the District with a report on February 2, 2018 indicating the presence of fecal coliform bacteria. Our observations on January 26, 2018 indicated the presence of effluent over much of the surface of the frozen Green.

   - District representatives processed our findings and quickly sought to identify System problems and find solutions, including interaction with Terry Shearer.
   - It is our understanding that peak daily use may have been substantially less than 4,000 gpd at the time of the effluent reaching the surface of the ice above the Green. We are continuing to work with District representatives to understand water meter flows, which will be necessary for permitting repairs and/or replacement of the existing System (we understand that flows in February 2018 may have been less than 2,500 gpd, which is a fraction of the design capacity of the 1988 System).
   - The low flows at the time of our sampling, with respect to the original System design flows, were a source of great concern for us and District representatives relative to the status of the System, the safety of students, and public safety.

f. The District asked us to simultaneously assist with VANR coordination and clarification following a February 2018 Project Review Sheet (PRS) for the inclusion of a Pre-K program. This effort culminated in an updated PRS on June 20, 2018 allowing the Pre-K program with conditions District representatives have continued to address.

g. District representatives asked us to explore off-site alternatives that led to our August 31, 2018 summary. We have assisted the District with further analysis of alternatives, which is discussed later in this document.

2. Current Rules: Chapter 1 of the VANR Department of Environmental Conservation Drinking Water and Groundwater Protection Division Environmental Protection Rules is entitled, “Wastewater System and Potable Water Supply Rules” (Rules), Effective April

12, 2019, define System failure under section 1-201 Definitions as follows:

(32) Failed System– means:
(A) a wastewater system that is functioning in a manner:
  (i) that allows wastewater to be exposed to the open air, to pool on the surface of the ground, to discharge directly to surface water, or to back up into a building or structure, unless in any of these instances the approved design of the system specifically requires the system to function in such a manner; or
  (ii) that results in a potable water supply being affirmatively determined by the Secretary to be a failed supply and such determination has been posted on the Agency website.
(B) Notwithstanding the provisions above, a system shall not be a failed system if:
  (i) these effects can be and are remedied solely by a minor repair or minor replacement; or
  (ii) these effects have lasted for only a brief period of time, the cause of the failure has been determined to be an unusual and nonrecurring event, and the system has recovered from the state of failure. Systems that have recurring, continuing, or seasonal failures shall be considered to be failed systems.

In brief summary, our observations of the system in 2018 indicate that the System is in failure and it appears, based on information provided by others, that the System has been in failure for a number of years. It is important to note that the System has not been functioning to manage effluent as designed and improved for 10,000 gpd.

3. The Existing System as Designed and Approved: The LeClair/WHN System was presented as Attachment 4B in our August 31, 2018 conceptual summary and inserted on aerial information in Attachment 5. It is not clear whether the System experienced flows in the range of 10,000 gpd as permitted. It is clear that the System has been in failure for many years and that substantially decreased flows from MCS still periodically punctuate the failed condition of the System. District Representatives have asked us to evaluate the existing System, potential rule changes that have affected the System, and offer suggestions to optimize use of the System during the exploration of alternatives.

a. Design plans show that the existing System includes four pressure distribution system (PDS) leachfields as described previously. The System includes:

- 5,000 gallon and 4,000 gallon septic tanks in series.
- A combination “dosing chamber” and pump chamber to direct effluent to each PDS (the dosing chamber provides additional storage for the pump station as designed).
- A valve chamber to manage effluent to the selected PDS.

b. Design plans show that the leachfields include 12-inches of 3/4" to 1-1/2" washed stone. 2-inch diameter PVC pipes are installed as laterals in each PDS with the top of each pipe 2-inches below the top of washed stone beds.

c. Design plans call for 6-inches to 12-inches of cover indicating that the design intent was for the tops of pipes to be 8-inches to 14-inches below ground surface (with bed bottoms 18-inches to 24-inches below ground surface).

d. Given the fact that the existing System appears to have been designed and installed according to the Rules, and WHN findings indicated adequate hydrogeological capacity for the System, why did the System fail so quickly? Our experience with many projects, including systems near the surface, suggest that frost, use of the Green as a playground, use of the Green by the general public, and possibly vehicle loads over the years contributed to System failure. While we believe that System operation may also have contributed to System problems, we are not aware of anecdotal information that suggests problems in early fall months prior to freezing conditions.

- It is our belief, based on experience with thousands of projects in this area, that frost is the key factor that contributed to, and continues to contribute to, System problems.
- Vacation time and low use during frozen conditions likely play an important role in freezing conditions.
- Playground and pedestrian access to the Green eliminates the potential for snow to act as a buffer against freezing.
- The status of the System with soil "piping," which has distributed effluent in various locations on the Green, suggests that operation of the System needs to be modified as soon as possible.

e. Since we also believe that System operation is likely now a contributing factor to the problems encountered, we are working with District representatives and the District's consulting team to evaluate operational alternatives in the near term in the hope of better managing effluent directed to PDSs, including providing effluent to leachfields during vacations in frozen conditions.

4. Current Hydrogeological Evaluation: Although WHN (now Heindel & Noyes) is a reputable firm, we encouraged the District to engage a separate hydrologist, which it did by accepting an initial proposal dated April 25, 2019 from Lincoln Applied Geology, Inc. (LAG).

a. The initial LAG scope was prepared with the knowledge that access to the Green would not be possible during the wettest months of the year (e.g., March, April, and May), after review of the WHN report information provided by the VANR, and in the context of teaming with our staff to evaluate existing conditions. Although the LAG scope acknowledged System design flows of 10,000 gpd, we subsequently discussed with LAG and the District evaluating the Green in consideration of lower flows.

- Task 1 included soil evaluation, which Steve Revell did in concert with Tim McCormick in our office (who is a Licensed Designer, a Certified Soil Scientist, and a Certified Wetland Scientist) and Terry Shearer on June 13 of this year. Our test pit logs and locations will be included with

LAG's initial services report.
- Task 2 included borings and conversion of borings to monitoring wells. Our surveying staff located borings, which will be shown on a graphic in LAG's initial services report.
- Task 3 included hydraulic conductivity testing of three monitoring wells.
- Task 4 included data analysis of initial service findings.

b. Through our interaction with LAG, it appears that we are in agreement that frost is likely the most significant factor that contributed to initial System issues and problems over ensuing years. We are continuing to discuss System, soil depth, and regulatory issues with LAG and hope to receive input from Terry Shearer in the near future about next steps.

- We have discussed the distribution of effluent over much of the Green, which we presume is the result of "piping" in frozen conditions where effluent sought the path of least resistance during a pump cycle and reached the ground/ice surface. Since we cannot map these subsurface conduits, replacement of the existing System and soil proximate to the System is likely the only way to cut off a future recurrence of this problem in concert with other System modifications.
- At a minimum, pedestrian access on the Green proximate to the System needs to be prevented to allow the accumulation of snow as an insulation buffer.
- We continue to discuss operational modifications during the coming winter with LAG and District representatives; we will also discuss operational modifications with Terry Shearer.

c. Our test pit analysis, which would be the basis for System design, suggest a seasonal high water table (SHWT) between 5.5 and 6 feet below ground surface. Our understanding from preliminary information developed by LAG is that soil borings indicate a water table between 7 and 8 feet, which LAG has noted seems to match WHN's original findings.

- Looking at the original design, which placed bed bottoms at 2 feet below ground surface in consideration of conservative System factors, approximately 3.5 feet exist between bed bottoms and the SWHT in the worst case.
- LAG used industry modeling practices to evaluate effluent mounding as part of its preliminary information gathering. In lay terms, mounding is a means of describing the hydraulic (effluent) depth above the SHWT, which should be below the bottom of a leachfield for a system to work.
    - LAG's preliminary evaluation of mounding for the current PRS flow of 5,460 gpd is 4.20 feet based on the current operation of the System, which exceeds the 3.5 feet available between the SHWT and the bottom of the leachfield.
    - LAG's preliminary evaluation suggests that mounding may be

reduced to 2.10 feet by changing system operation, which theoretically suggests that the existing System may be less likely to exhibit failure with a different approach to applying effluent to the PDSs.

- Discussions with LAG suggest that the original System design and operation to accommodate 10,000 gpd may have generated a theoretical effluent mound above ground surface.

- The uncertainty and complexity of establishing what is actually taking place in the existing System, and the difficulty of providing the District with a replacement system that may be more reliable warrants consideration of other possibilities.

  - We have queried Terry Shearer about the possibility of raising the leachfields to increase the distance between the SHWT and the bottom of each bed. This would create what is referred to as a "mound" in the area of the System.
  - VANR Rules allow cover over the top of beds up to 3 feet. While we would offer concerns about reduced aerobic function with more cover over beds, additional cover would create an additional layer of insulation, but would not increase the distance between the SHWT and the bottom of the System (if the VANR requires the District to maintain the current bed bottom elevation).
  - In all cases, insulation, fencing to prevent access to the System replacement area, and operational modifications will be necessary.

d. Following receipt of guidance from Terry Shearer, we can recommend additional services for LAG including monitoring well evaluation over the winter and from March to May next year, additional mounding analyses for various System and operational approaches, and design input if the District chooses to proceed with a replacement System on the Green.

5. System Replacement Costs: In the context of previous requests by District representatives to provide an understanding of relative costs for System replacement and various alternatives, we suggested the following relative costs:

<u>In our August 31, 2018 summary</u>: "For the purpose of order of magnitude budgeting, we would recommend use of $50/gallon to replace the existing system, or approximately $275,000. Although this macro budget considers only System replacement, it is helpful to understand the scale of repair needs, particularly if the 10 year cycle of repair continues."

<u>In our August 18, 2019 email update, we provided the following additional information</u>:

"1. <u>Existing System</u>: In our August 31, 2018 conceptual evaluation, we noted that the existing system is permitted for 5,460 gallons per day (gpd), which includes 364 students and staff. We also suggested a relative unit cost of $50/gallon as a

means of providing a relative system replacement cost of approximately $275,000 without consideration of mechanical improvements.

a. Our evaluation of actual system and soil conditions indicate that the system consists of four beds that were originally designed to address 5,000 gallons each; each bed includes 4,200 square feet (SF) of area. Another conceptual method to evaluate cost could consider the SF for each bed. In this context, we would suggest a conceptual unit cost of $25/SF, or $105,000 to replace each bed. If we assume that all four beds need to be replaced based on historic conditions, potential replacement costs will be in the relative realm of $420,000 for the existing system without consideration of mechanical improvements.
b. Mechanical improvements should include replacing existing valves and controls, adjusting or replacing pumps to adjust dose rates, and inclusion of controls and telemetry to eliminate the need for manually cycling between beds. Although we have not defined specific mechanical modifications, we would suggest a conceptual placeholder of $75,000 for these improvements.
c. Fencing will be needed to prevent access to the new system. Assuming approximately 900 linear feet (LF), at a unit cost of $35/LF, suggests a conceptual cost of $31,500 to protect the new system.
d. Until we know whether all four beds in the existing system need to be replaced, we suggest consideration of a relative conceptual cost between $381,500 and $526,500, which will need to be refined following completion of the LAG evaluation and regulatory input."

District representatives have requested a more definitive understanding of costs to replace the existing system. To assist with clarifying replacement costs, we offer the following:

a. The attached Conceptual Engineer's Opinion of Probable Cost (EOPC) dated October 11, 2019 looks at reconstruction/in-kind replacement of the existing System using the LeClair plan based on our ongoing database that includes many local and regional projects. We anticipate that replacement of only the existing beds to be in the range of $300,000. Mechanical upgrades and fill to change leachfield elevations will likely significantly raise costs for replacement of the existing System to levels near the "high end" of our previous relative numbers.

    - Without further evaluation and concurrence about System operation, it is difficult to suggest a budget for mechanical upgrades.
    - Raising beds three feet will require approximately 2,060 cubic yards (CY) of additional material for each bed, which at a unit cost of $18/CY to $22/CY will cost approximately $40,000 more per bed, or $160,000 for the System.

The Peisch Property

With assistance from the Norwich Public Works Department, we observed 11 test pits on the Peisch property, developed soil logs from our findings, and provided a sketch showing test pit

locations and wetlands connected to the brook and wetlands proximate to the brook. Tim McCormick, CWS, met with Rebecca Chalmers, District Wetland Ecologist, in the summer of 2018 to confirm that wetlands along the brook are Class II, which require a 50-foot setback, including the wetland Tim sketched because it is connected to the brook complex. In brief summary, this site has limited capacity for on-site wastewater disposal and is not a viable replacement option for MCS, which we discussed with Terry Shearer on April 12 of this year. Additionally, using the Vermont Center for Geographic Information (VCGI), we generated a base plan to evaluate the site, but we did not modify or update the base plan or our work after understanding that the Peisch property would not provide a viable replacement solution.

Municipal Connections

Given the District's pursuit of a Memorandum of Understanding with the Town of Hartford, we have not devoted additional effort to job creation funding from CDBG, which we understand allows $40,000/job up to $1,000,000 (e.g., 25 jobs between The Car Store, King Arthur Flour, and Norwich Commerce Park with a Hartford connection). Consequently, we reiterate information presented in our August 18, 2019 email update, which included the following:

"2. Town of Hanover Municipal Connection: We recall assisting the New Hampshire Department of Transportation (NHDOT) with Ledyard Bridge improvements, which included installation of sub-slab piping and bridge foundation penetrations to accommodate water and sewer (we need to confirm actual conditions if the District chooses to proceed with this option).

a. The distance from Girard Drive to the eastern slab of Ledyard Bridge is approximately 4,200 LF. Assuming a conceptual unit cost of $210/LF for directional drilling, the conceptual cost for sewer from MCS to the Bridge will be in the range of $882,000.
b. The Bridge is approximately 500 LF from the Norwich abutment to the Hanover abutment. At an initial conceptual unit cost of $800/LF, "hanging" a sewer line on the Bridge will be in the range of $400,000.
c. Mechanical costs at the MCS site should include telemetry, a new pump station, a generator, and at least a small shed for controls. We suggest a conceptual cost of approximately $155,000 for these elements without consideration of upgrades to existing Town of Hanover facilities.
d. Although we need to better understand all elements of this option, the relative conceptual cost will be in the range of $1,437,000.
e. We understand that this option would require an agreement between the Towns of Norwich and Hanover (e.g., we understand that you have indicated that the District may not enter directly into an agreement with the Town of Hanover).

3. Town of Hartford Municipal Connection: In keeping with our previous evaluation of a municipal connection to the Town of Hartford, we offer the following:

a. The distance from King Arthur Flour to Olcott Drive is approximately 3,200 LF, which, at a unit cost of $210/LF for directional drilling, suggests a conceptual cost of $672,000.
b. The distance from MCS to King Arthur Flour is approximately 3,800 LF, which, at a unit cost of $210/LF for directional drilling, suggests a conceptual cost of

$798,000.

c. Using the same conceptual mechanical upgrades used for a connection to the Town of Hanover suggests a conceptual budget of $155,000.

d. It is not clear to us whether any upgrades to the Hartford system will be needed to accommodate this project. Additionally, although we acknowledge that King Arthur Flour will have additional costs for pump and treatment system modifications, we have not included such improvements in the contest of MCS capital needs.

e. Although we need to better understand all elements of this option, the relative conceptual cost for this option will be in the range of $1,625,000."

Dresden Recreation Fields Property

We have not devoted any additional effort to consider this option and reiterate information presented in our August 18, 2019 email update, which included the following:

"4. Dresden Recreation Fields: Although we have not conducted soil investigations to assess the potential for a system on the Dresden Recreation Fields to serve MCS, we have created a base map using publicly available information. In general, the primary difference between this option and a connection to the Hartford system is a reduction of 2,000 LF, which is the approximate distance between the entrance to the Dresden Recreation Fields and Olcott Drive. Using a unit cost of $210/LF for directional drilling suggests a reduction of $420,000 when compared to the Hartford municipal option, or a relative conceptual cost in the range of $1,205,000."

This summary sought to provide relative information that does not include costs for a new System on the Dresden Recreation Fields property.

Pumping The Existing System

Although we have not previously published this option, we have discussed with District representatives that a possible solution is to pump existing septic tanks on a weekly basis (frequency to be determined) to eliminate the possibility of effluent reaching the surface of the Green. We understand that the District is pursuing an assessment of these costs.

Other Alternatives

We remain prepared to assist the District with evaluating other alternatives. We understand that a member of the public recently suggested use of composting toilets like Vermont Law School (VLS), which we discussed with Terry Shearer. In short, VANR rules allow composting toilets for 25% of flow requirements (the remaining 75% of the flow would need to be treated in a system). Terry noted that VLS is not a good analogy because it receives municipal water and sewer service.

In closing, if the District would like to proceed with replacement of the existing System, we should discuss system sizing based on the need to evaluate the "strength" of the existing waste stream, inclusion of a kitchen, programming, student and staff needs, growth, and design

parameters. Although we can address regulatory requirements, like LeClair and WHN did with the 1988 System design, neither we nor LAG can provide guarantees about a replacement system on the Green because all on-site systems have a limited life span. As a reminder, all of our conceptual efforts have only considered so-called "hard" costs for each alternative, each of which will require further "soft" costs in terms of exploring site conditions, regulator interaction, design, permitting, and implementation. Please let me know if you have any questions about our approach.

Sincerely,

PATHWAYS CONSULTING, LLC

Jeffrey S. Goodrich, P.E.
President

JSG:sef

Enclosure

CONCEPTUAL ENGINEER'S OPINION OF PROBABLE COST
MARION CROSS SCHOOL WASTEWATER SYSTEM REPLACEMENT
REPLACE FIELDS AND PRESSURE DISTRIBUTION IN KIND OPTION
NORWICH, VERMONT
PREPARED BY PATHWAYS CONSULTING, LLC (Project No. 11647)
October 11, 2019

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1.00	**DEMOLITION (BASE ESTIMATE, FIELDS/DISTRIBUTION)**				
1.01	Stripping Loam from Fields and Screening (Assume 6")	315	CY	$20.00	$6,300.00
1.02	Excavate and Dispose of all Fields to Bottom of Stone (16,800 SF, Assume 6" of Cover and 12" of Stone) (Disposal at Certified Location, Pipe Incidental)	940	CY	$50.00	$47,000.00
1.03	Remove and Dispose of 8" Pressure Main and Valves to Pump Chamber	310	LF	$10.00	$3,100.00
1.04	Miscellaneous Demo Allowance	1	AL	$10,000.00	$10,000.00
DEMOLITION (BASE ESTIMATE, FIELDS/DISTRIBUTION) SUBTOTAL					**$56,400.00**
2.00	**REPLACE FIELDS AND DISTRIBUTION PRESSURE LINE (BASE ESTIMATE)**				
2.01	2" Sch. 40 Perforated Field Piping	2,880	LF	$25.00	$72,000.00
2.02	8" Sch. 40 Field Distribution Pipe	140	LF	$40.00	$5,600.00
2.03	8" to 2" Sch. 40 Manifolds	29	EA	$250.00	$7,250.00
2.04	8" Sch. 40 Pressure Pipe from Pump Chamber (Excavation and Sand Backill Incidental)	310	LF	$60.00	$18,600.00
2.05	8" Gate Valve with Box	2	EA	$2,500.00	$5,000.00
2.06	Field Stone (3/4") 16,800 SF	630	CY	$40.00	$25,200.00
2.07	Field Fabric (Above Stone)	2,100	SY	$4.00	$8,400.00
2.08	6" Sand (Above Stone)	315	CY	$26.00	$8,190.00
2.09	6" Screened Loam from Onsite Material (Fields)	315	CY	$15.00	$4,725.00
2.10	Restoration of Lawns (Trenching areas and Access)	1	AL	$5,000.00	$5,000.00
2.11	Seed and Mulch (Fields)	2,100	SY	$4.00	$8,400.00
REPLACE FIELDS AND DISTRIBUTION PRESSURE LINE (BASE ESTIMATE)					**$168,365.00**
2.00	**MOBILIZATION/DEMOBILIZATION/MISCELLANEOUS WORK AND CLEANUP**				
2.01	Mobilization/Demobilization (Assume 10% of Construction Cost)	1	LS	$22,476.50	$22,476.50
2.02	Miscellaneous Work and Cleanup (Assume 5% of Total Construction Cost)	1	LS	$11,238.25	$11,238.25
MOBILIZATION/DEMOBILIZATION/MISCELLANEOUS WORK AND CLEANUP TOTAL					**$33,714.75**

SUMMARY OF CONCEPTUAL OPINION OF PROBABLE COST	
TOTAL OPINION OF PROBABLE COST	**$258,479.75**
15% CONSTRUCTION CONTINGENCY	**$38,771.96**
TOTAL OPINION OF PROBABLE COST WITH CONTINGENCY	**$297,251.71**

Note: This Engineer's Opinion of Probable Cost (EOPC) was established from the original design plans titled, "Sewage Disposal System Design, Marion Cross School" by K.A. Laclair Assoc., Inc., dated April 21,1988, revised June 26, 1988. In providing this EOPC, the Client understands that Pathways Consulting, LLC (Pathways) has no control over the unit costs or availability of labor, equipment or materials, market conditions, or the Contractor's method of pricing. This EOPC was developed on the basis of experience with similar projects, including current unit prices that have been received by Pathways for similar projects. Pathways makes no warranty, express or implied, that the bid, or the negotiated cost of the work for this project will not vary from this EOPC. Upon completion of the final construction drawings and prior to construction of the project, Pathways may revise this EOPC to reflect actual design parameters and updated construction costs.